



Enhancing demand side flexibility in Nordhavn buildings for integrated multi-energy systems

Li, Rongling; Wang, Jiawei; Zong, Yi; Foteinaki, Kyriaki; Rode, Carsten

Published in:
Book of Abstracts, Sustain 2017

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Li, R., Wang, J., Zong, Y., Foteinaki, K., & Rode, C. (2017). Enhancing demand side flexibility in Nordhavn buildings for integrated multi-energy systems. In *Book of Abstracts, Sustain 2017* [L-9] Technical University of Denmark.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Enhancing demand side flexibility in Nordhavn buildings for integrated multi-energy systems

Rongling Li^{*1}, Jiawei Wang², Yi Zong², Kyriaki Foteinaki¹, Carsten Rode¹

1 DTU Civil Engineering; 2 DTU Electrical Engineering

*Corresponding author email: liron@byg.dtu.dk

EnergyLab Nordhavn is a large-scale research and demonstration project based in the Nordhavn neighborhood of Copenhagen, one of the largest urban development districts in Europe (EnergyLab Nordhavn, 2015). The district functions as a living laboratory for testing smart energy technologies, business models, and operational solutions at every level – component, building, and grid. Buildings are crucial elements in smart energy solutions due to their function of coupling different energy sectors on the demand side and their considerable potential for offering flexible energy consumptions as energy system services. Energy flexibility in buildings can be distinguished in two forms: thermal flexibility and electrical flexibility.

Thermal flexibility of buildings were investigated to explore the potential services could be provided to district heating grids. Field measurements were conducted aiming to find a solution to eliminate the use of peak load boilers in the heat production. The results indicated that residential buildings had large thermal flexibility potential as the supply water temperature could be reduced significantly; however, office buildings had greater potential for heat conservation due to its greater heat demand (Sandersen, 2017). Modeling and simulation studies were carried out to investigate the thermal flexibility of various building designs. The thermal flexibility was strongly influenced by thermal insulation of building envelope, outdoor conditions and occupant behavior. Building thermal mass was found to be influential only if the thermal resistance of the envelope was sufficient (Sarran, 2016). Floor heating system was found to be the most flexible system in comparison with radiator heating and air heating (Zilio, 2016).

To achieve 100% renewable energy generation by 2050 in Denmark, electrical flexibility is required in order to ensure a reliable and balanced power system operation during variation of renewable energy generation (Ma, 2013). Besides the smart grid-oriented demand response program running with appliances in residential buildings, the electrical flexibility through buildings can be realized by utilization of electrically driven heating units, e.g. heat pumps and electric boosters. The demand side flexibility provided by cross-energy sectors can contribute to higher renewable energy penetration (Yi, 2016 & 2017). The simulation results of an economic model predictive control-based energy management system for the heating system in the apartments of the Nordhavn area show that the flexible consumption and integrated multi-energy systems must be developed with correlative dependence and interplay to meet the challenge of integrated fluctuating renewables.

Sandersen, 2017. Thermal flexibility in different building in a district heating network.

Sarran, 2016. Impact of building design parameters on energy flexibility in Nordhavn district.

Zilio, 2016. Analysis of building services systems for flexible operation of buildings in smart city district Nordhavn.

EnergyLab Nordhavn, 2015. <http://www.energylabnordhavn.dk/>

Ma, 2013. Evaluating and planning flexibility in sustainable power systems

Yi, 2017. Enhancing Wind Power Integration through Optimal Use of Flexibility in Multi-Carrier Energy Systems from the Danish Perspective

Yi, 2016. Challenges of implementing economic model predictive control strategy for buildings interacting with smart energy systems